Assistance Agreement Quarterly Report: 7th Quarter

Date of Report: December 7, 2001

Agreement No: R82806301

Title: **Baltimore Supersite: Highly Time and Size Resolved Concentrations of Urban PM2.5 and its Constituents for Resolution of Sources and Immune Responses**

Investigators: **J. M. Ondov**, Department of Chemistry and Biochemistry, University of Maryland, College Park, MD; **T. J. Buckley,** School of Hygiene and Public Health, Johns-Hopkins University, Baltimore, MD; **P. K. Hopke**, Clarkson University, Potsdam, NY; **M. B. Parlange**, Johns-Hopkins University, Baltimore, MD; **W. F. Rogge**, Department of Civil and Environmental Engineering, Florida International University, Miami, Florida; **K. S. Squibb**, Department of Pathology, University of Maryland at Baltimore; and **A. S. Wexler**, University of California, Davis, CA

Institution: Department of Chemistry and Biochemistry, University of Maryland, College Park, MD

Research Category: Particulate Matter Supersites Program
Project Period: January 15, 2000 to December 31, 2003

Objectives of Research: Our primary objectives are to i) provide an extended, ultra high-quality multivariate data set, with unprecedented temporal resolution, designed to take maximum advantage of advanced new factor analysis and state-of-the-art multivariate statistical techniques; ii) provide important information on the potential for health effects of particles from specific sources and generic types of sources, iii) provide large quantities of well characterized urban PM for retrospective chemical, physical, biologic analyses and toxicological testing, iv) provide sorely needed data on the sources and nature of organic aerosol presently unavailable for the region, v) provide support to existing exposure and epidemiologic studies to achieve enhanced evaluation of health outcome-pollutant and -source relationships, and vi) test the specific hypothesis listed in our proposal.

Status

As described in our previous report, the Baltimore Supersite trailers were installed at the FMC Corp. site, near Brooklyn and a nominally 20-day intensive sampling program was conducted, beginning in the second week in May and ending on June 10th. Additional measurements were made with some of the instruments until June 15th. The trailers were moved to Clifton Park and installed to temporary power during the last

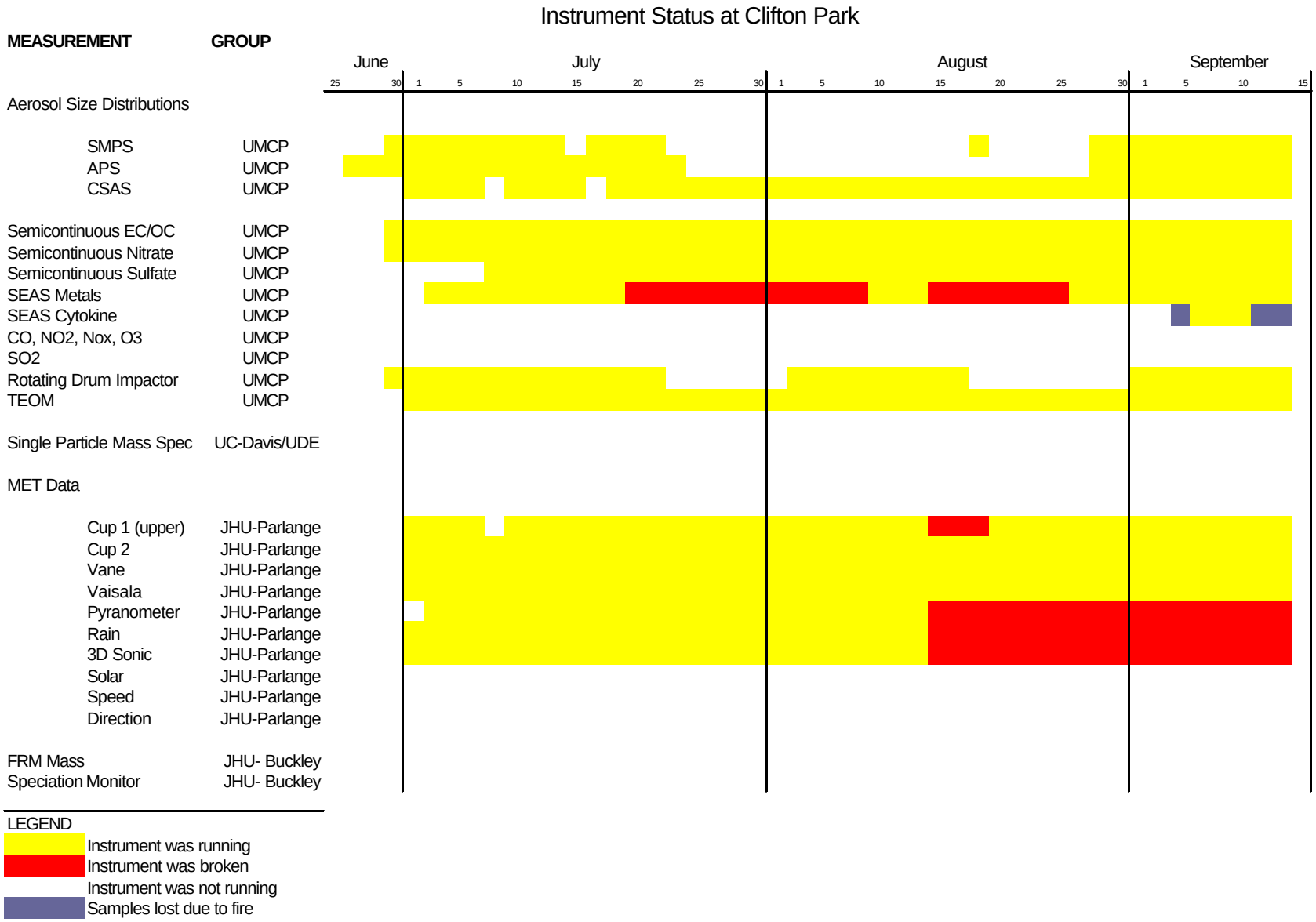

Figure 1. Instruments operated at the Clifton Park Supersite in 2001. The site was shutdown by fire on Sept. 14, 2001.

week in June. Measurements were begun on June 30 with some instruments, other instruments were phased-in as indicated in Figure 1, above. Measurements made with several of the instruments, including SEAS metals, SEAS cytokines, and all of the meteorological parameters were interrupted by lightning which struck quite near the site during the afternoon of August 13th. The data logger, met computer, both SEAS computers as well as the data acquisition and instrument control boards for our SEAS instruments were destroyed or damaged. Additionally, our ISDN router and LAN hub were also destroyed. These were replaced within the next three weeks. SEAS metals measurements were resumed on August 24th but valve problems precluded sample collection until the 27th. SEAS cytokine aerosol slurry collections were started on September 5th. All measurements ceased between 11:15 PM on September 14th and 00:15 AM, September 15th, when vandals forced entry into our compound and trailers and effectively destroyed virtually all of the instruments by fire. As described below, Met and Lidar data have been processed and several days worth of SEAS samples have been analyzed. The aerosol spectrometers (APS, SMPS, CSAS) and much of the EC/OC, TEOM, Nitrate, and Sulfate semicontinuous monitor data have not yet been processed. Some of the EC/OC, Sulfate, and Nitrate data are discussed below in the context of SEAS measurements.

Progress Summary/Accomplishments

Meteorological Data. On 6/30 the tower was erected and sensors were deployed. Continuous sampling began on 7/1 at 12:30 PM and ended on 9/15 at 02:00. Plots of data are available online at http://www.jhu.edu/~dogee/mbp/supersite2001/

We used the following instrumentation:

Instrument	Measured Variables	Completeness of Data	Non-functionality, reason
Rain Gage	Rain [mm] @ 1 Hz	100% (54% own sensor + 46% BWI weather station)	7/07 10:00 – 7/09 18:00 – labtop stolen 7/17 19:00 – 7/18 11:00 – datalogger connection error 7/18 21:26 – 7/19 16:30 –datalogger connection error 7/28 11:00 – 7/28 18:00 – wrong recorded data 8/13 11:00 – end: lightning, sent for repair rain gage: use hourly precip. data from NWS-BWI weather station (distance ~10 miles)
Cup anemometer 1	Magnitude of horizontal wind vector [m/s] @ 1 Hz	54%	
Pyranometer	Solar Radiation [W/m^2] @ 1Hz	54%	
CSAT 3-D Sonic anemometer	Velocities u,v,w [m/s], potential temperature [^o C] @ 20 Hz; friction velocity u_* [m/s], Monin Obukhov Length L [m], sensible heat flux H [W/m^2]	53%	In addition to above mentioned: 7/29 18:00 – 7/30 06:00– data erroneous
Cup anemometer 2	Magnitude of horizontal wind vector	94%	7/07 10:00 – 7/09 18:00– laptop stolen

	[m/s] @ 1 Hz		7/17 20:00 – 7/18 10:44– datalogger connection error 7/18 21:26 – 7/19 16:30- datalogger connection error 7/28 11:00 – 7/28 18:00 data erroneous 8/13 11:00 – 8/14 19:00 lightning
Wind Vane	Azimuth angle of wind vector [^o]; standard deviation of wind angle \sigma_{\theta} [^o]	94%	
Vaissala Temperature and Humidity Probe	Temperature [^o C] and relative humidity [%] @ 1 Hz	94%	

With respect to data quality all sensors functioned well (within errors specified by the manufacturer) for all times except the missing periods mentioned in the table. Intercomparison of velocity measurements from cup anemometers and wind angle measurement from wind vane with data from the 3-D sonic anemometer assured high data quality for these measurements. An offset of +5% occurred with the Vaisala Humidity probe, as it recorded values >100%. This instrument will be recalibrated for the upcoming intensive in January. Previous data will be corrected according to the calibration information. Solar radiation, mean wind speeds, temperature and humidity showed the expected diurnal variations. Moreover, turbulence parameters such as atmospheric stability and friction velocity showed corresponding behavior.
Regarding large scale weather patterns, which can be observed especially in the mean wind direction, the first half of July was characterized by wind direction around 315^o (300^o to 360^o). After that two different patterns were observed. One with a wind direction around 215$^{\wedge o}$ occurred on ~60% of the remaining days. It was characterized by diurnal variation with NNE-ward winds (210^o) turning to ENE-ward (240^o) later in the afternoon. The second pattern with typically smaller wind speeds exhibited wind directions of ~90^o (occurrence ~30%). The governing regime from the beginning of July repeated itself only during ~10% of the days after 7/15.

LIDAR. The JHU MEBL (Miniature Elastic Backscatter Lidar) system was deployed at the FMC site during the following days: May: 22, 23, 24, 25, 27, 28. and June: 5, 6, 7, 8, 9, 10, 11, 12, 13, 14. The system was relocated to the Clifton Park site on June 30th and operated there on the 3rd and 4th of June, aftterwhich onwards, technical difficulties prevented continuation of its operation. The power supply failed and had to be sent to the manufacturer for repair. Data collection was resumed with a fully functional system on August 14 and operated until August 16. All data was taken in a vertically upward pointing mode. As during the previous measurement periods, no data was collected during rain events. In order to comply with FAA regulations, the lidar system was only operated during the daytime. Also, the lidar system was shut down when an aircraft appeared in critical airspace in the vicinity of the system.

Data that has been taken during previous measurement periods is being analyzed. Figure 2 shows an example of the atmospheric boundary layer (ABL) height (solid line) as determined from the lidar signal. A newly developed gradient/contour method is used to delineate the ABL height from lidar data.

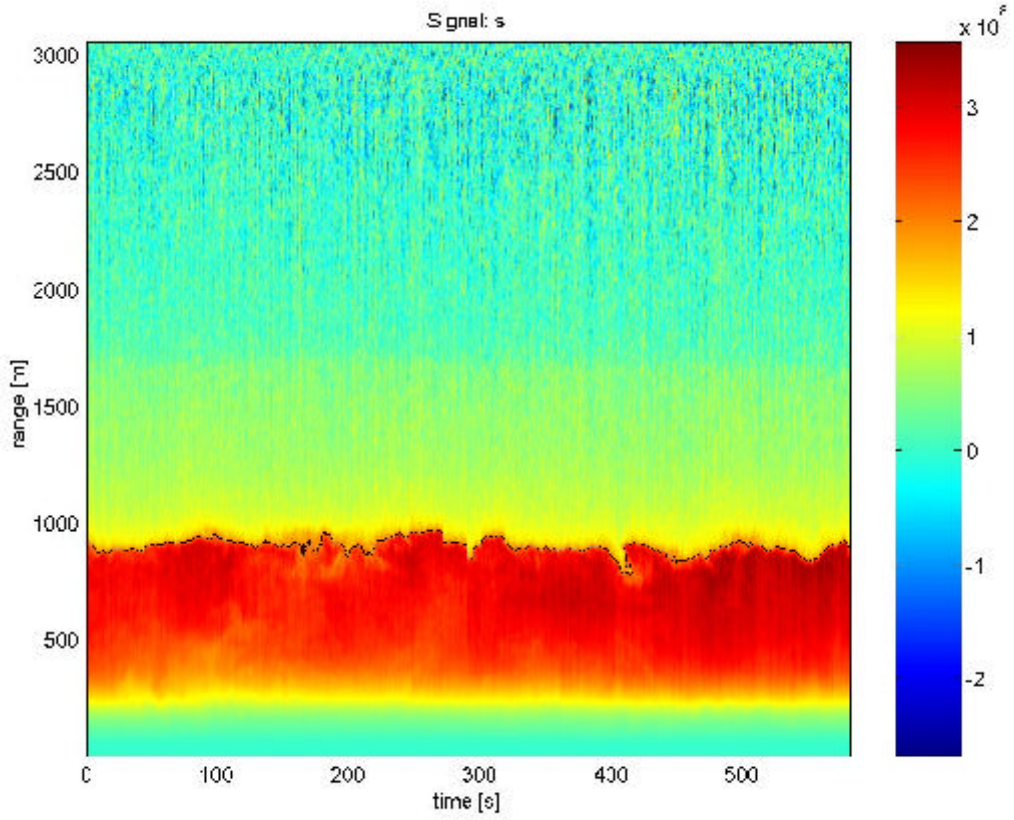

Figure 2: Vertical lidar scan from JHU MEBL taken on 23 May 2001 (starttime: 11:55am). Also shown is the ABL top (solid line), as determined using an advanced gradient/contour method.

The new algorithm is well suited to obtain the boundary layer height from lidar data under clear convective conditions. Cases in which clouds were present will have to be examined separately, since the large lidar signal received from clouds leads to misinterpretation of the ABL top when using the gradient method. An example for a lidar scan where clouds were present is shown in Figure 3.

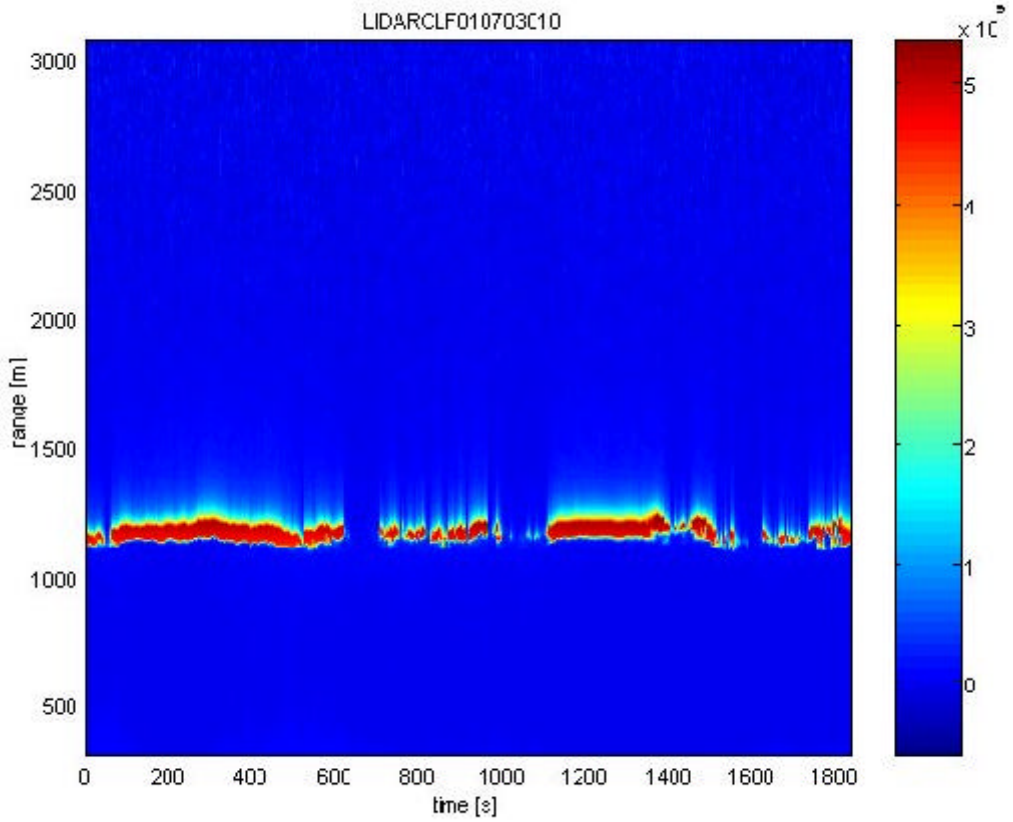

Figure 3. Vertical lidar scan taken with JHU MEBL under cloudy conditions.

It should be noted that this lidar data taken under cloudy conditions is very valuable. For example the cloud base and cloud thickness can be determined from this data. Furthermore, the energy budget, especially solar radiation is strongly affected by clouds. Therefore the lidar data will aid to understand better what effect clouds have e.g. on the energy balance and dispersal of pollutants from local sources. Two-dimensional images of relative particle concentration can be found in the lidar data archieve at. http://www.jhu.edu/~dogee/mbp/supersite2001/index.htm

SEAS metals. The UMCP SEAS metals system became operational at Clifton Park on July 3rd and was operated through July 18th, when the system was disassembled for repair. Operation was resumed on August 10th and was maintained until the lightning strike on 13 August, and thereafter, resumed on August 27th until September 14th. Successive 30 minute slurry samples collected on June 6, 7 , 8, 9, and10 were analyzed for 14 elements by Graphite Furnace Atomic Absorption Spectrometry. Data for Se, Ni, and Pb are shown in Figures 4, 5, 7, and 8. A map of Baltimore, showing the locations of various stationary sources is shown in Figure 6. Selenium is an excellent, nearly unique, inherent tracer of primary particles emitted from coal combustion. Likewise, Ni is a good tracer of oil combustion. The source of Pb is unknown.

As shown in Figure 4, Selenium (Se) concentrations peaked regularly when winds arrived at Clifton Park from directions ranging from approximately 150 to 220º. This is likely the influence of plumes from the BG&E Brandon Shores and Wagner stations which lie about 16 km from Clifton Park at an angle of 165 and 166º (see Figure 6).

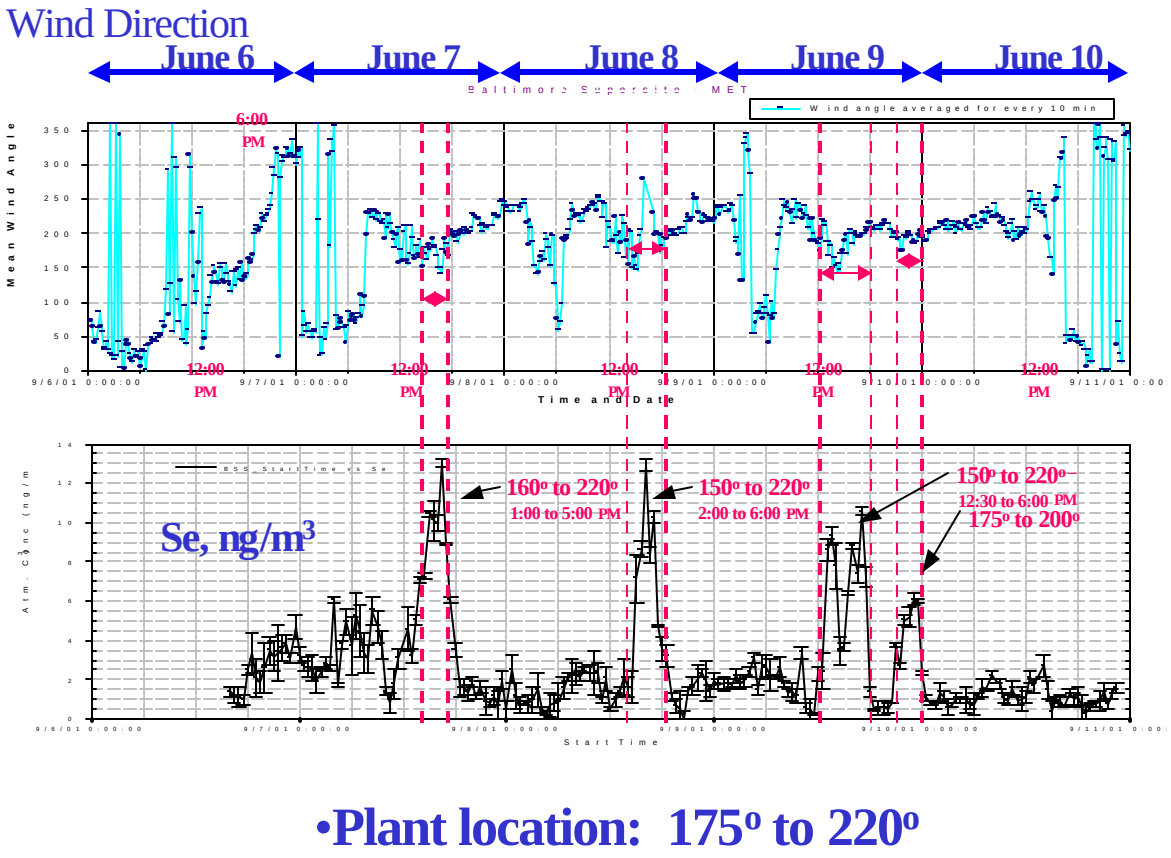

Figure 4. Wind direction and 30-min Se data for aerosol particles collected at Clifton Park.

As shown in Figure 5, peak Se concentrations were as large as 12 ng/m^3, i.e, about 12-fold greater than Se background concentrations, which were typically about 1±1 ng/m^3. Clearly, the daily average concentration (2.2 ng/m^3,) was strongly affected by fumigation by these plumes. This is, perhaps, important as it indicates that one or two sources might dominate human exposure to certain pollutants.

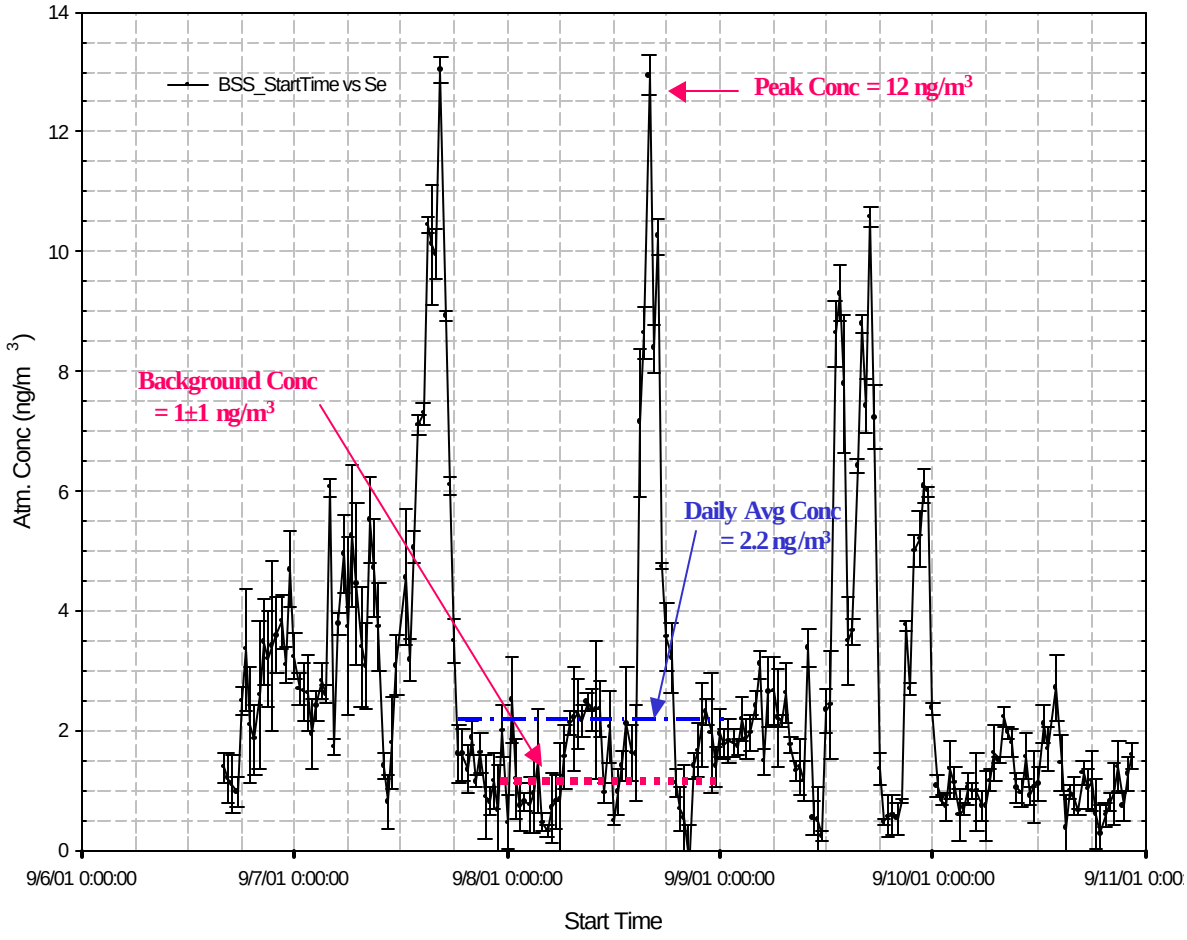

Figure 5. Time series of airborne selenium concentrations measured at Clifton Park on September 6th though September 10th, 2001, indicate that fumigation by plumes from stationary coal combustion sources for <25% of the day result in a doubling in the 24-hr average concentration of this element.

Baltimore Supersite PM10 Sources

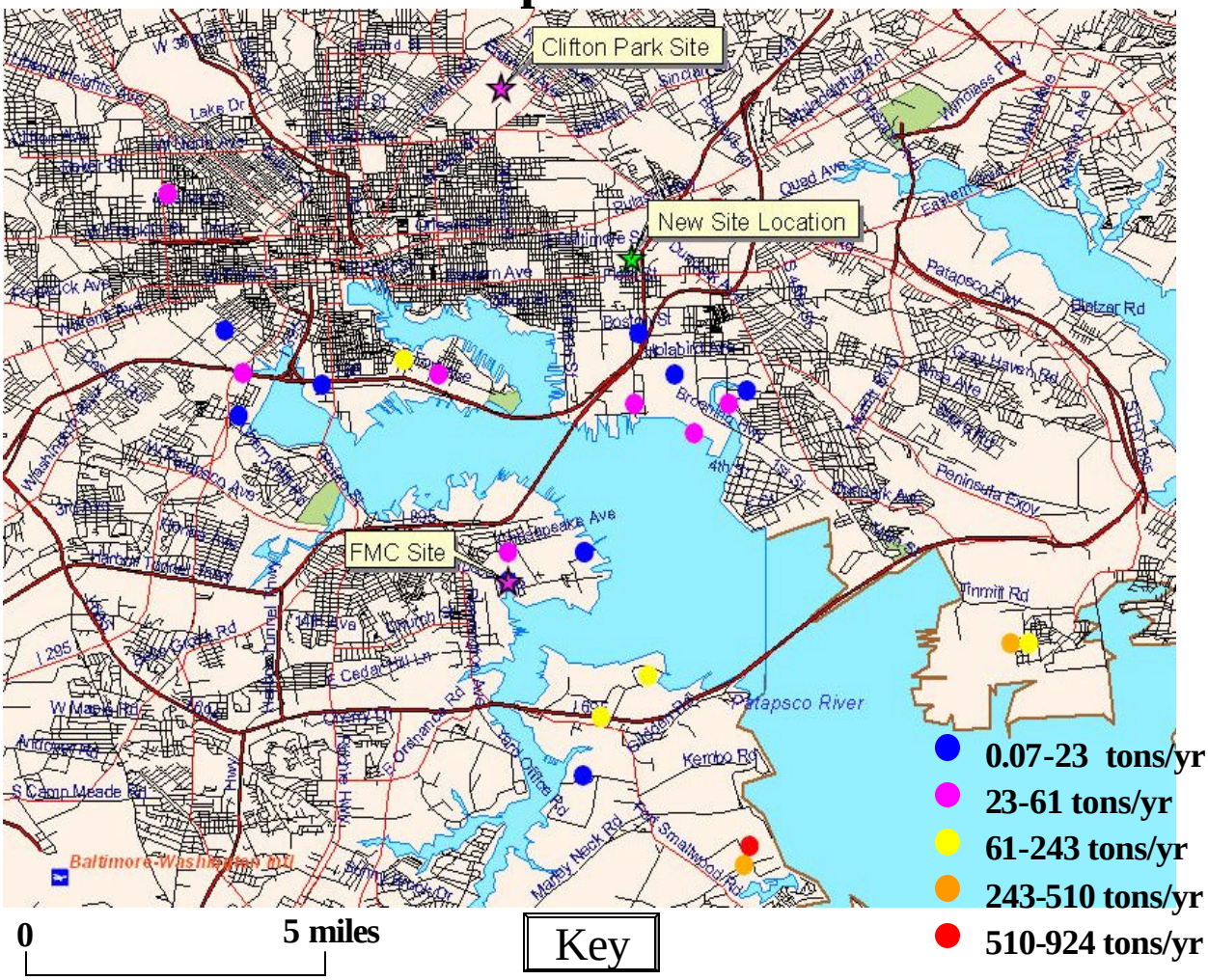

Figure 6. Map of Baltimore area showing the locations of major stationary sources and Supersites.

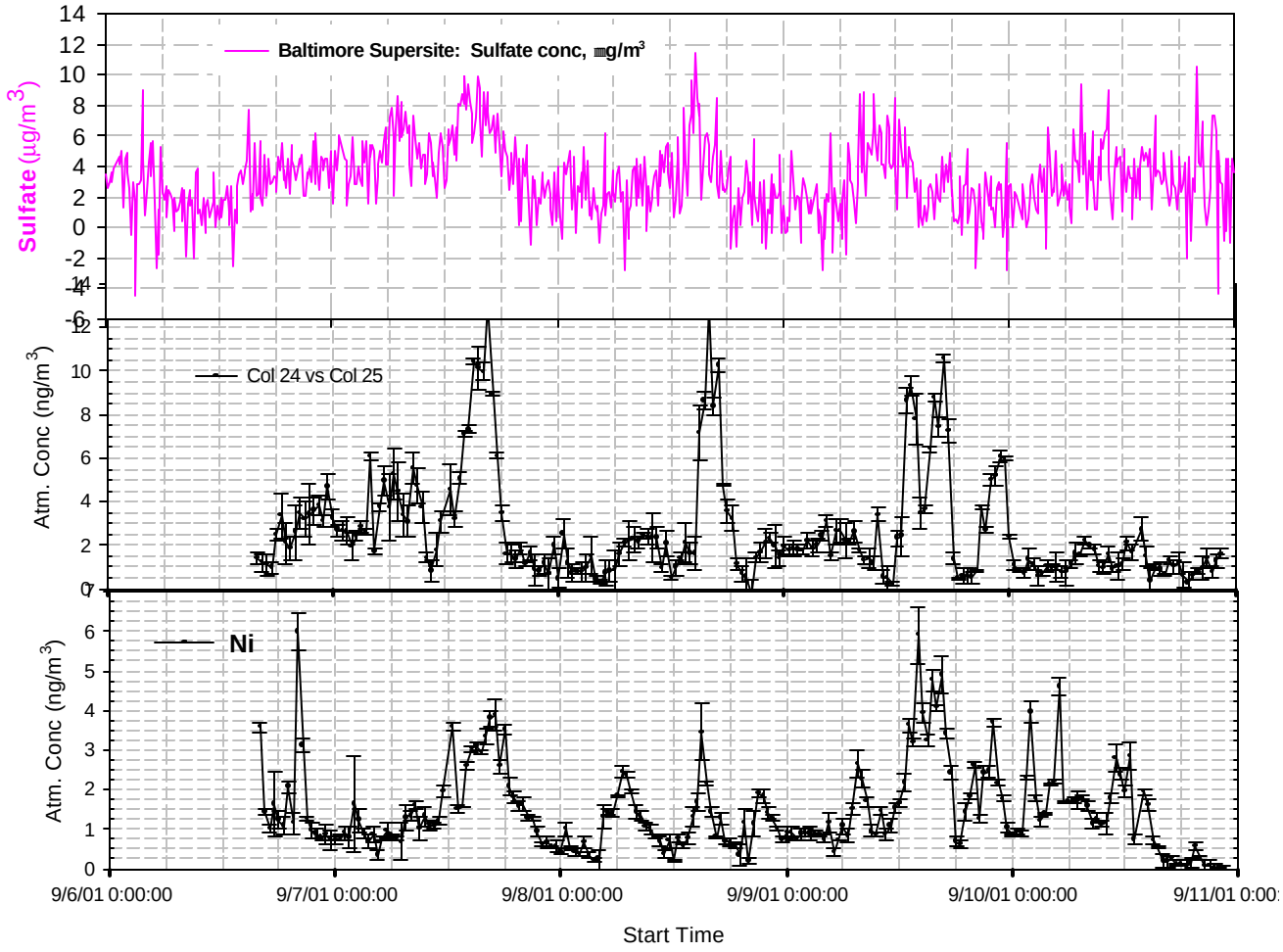

Figure 7. Concentrations of particulate sulfate, selenium, and Nickel (top, center, and bottom panels, respectively) measured at Clifton Park from the evening of September 6th through the end of September 10th.

As shown in Figure 7, Ni concentrations were also somewhat elevated during most of the same periods as Se. This is surely attributable to emissions from an oil-fired boilers at the Wagner Utility station. As Wagner burns oil and coal while Brandon shores burns only coal, their contributions should be resolvable by factor analysis or CMB methods.

Interestingly, sulfate concentrations are elevated shortly before Se concentrations become elevated. On at least one occasion, periods of plume fumigation observed via SEAS measurements at the Pittsburgh Supersite corresponded to some of the lowest sulfate concentrations measured at that site, suggesting very

little contribution to ambient sulfate by local sources. Here in Baltimore, sulfate concentrations were quite low (there is a 35% bias in the data shown in Figure 7 due to an error in the concentration of SO_2 in commercially prepared "span" gas used to calibrate the sulfate monitor.), perhaps, so low, that local stationary combustion sources may effect ambient sulfate concentrations. However, this could possibly reflect higher sulfate background concentrations associated with winds from the direction of the Se source(s). Clearly, more data are needed to resolve this issue.

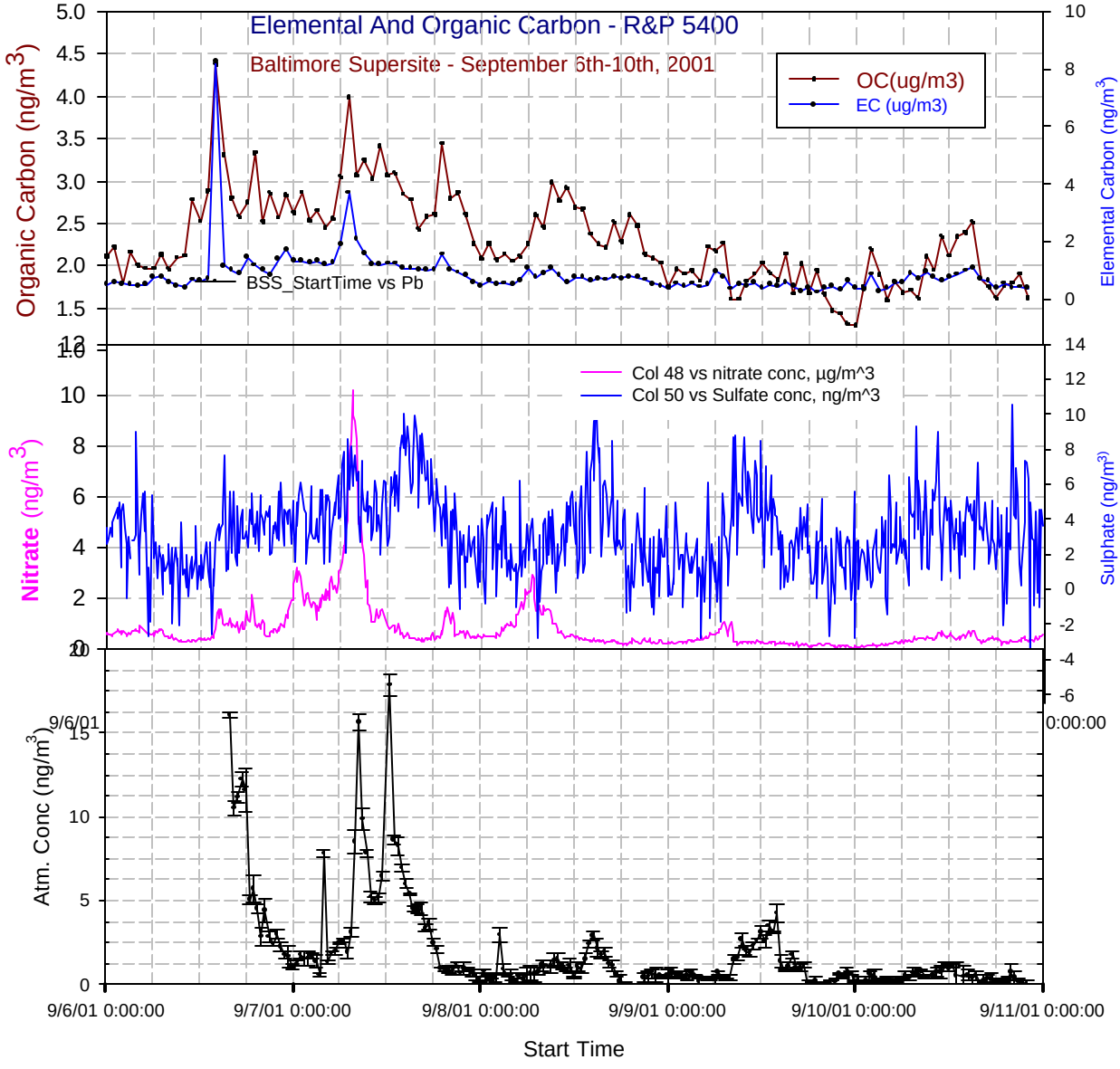

Figure 8. Concentrations of elemental and organic carbon (EC/OC), nitrate and sulfate, and Pb measured at Clifton Park from September 6th through midnight on Sunday, September 10th.

Concentrations of EC and OC, sulfate and nitrate, and Pb are shown, respectively, in the top, center, and bottom panels of Figure 8. As indicated in the top panel, there is some correlation between the most intense episodes of elevated EC and OC concentrations. Further analysis will need to be performed to determine if the lack of correlation during low concentration periods is the result of poor sensitivity for EC or other instrumental artifact. Clearly, the highest Organic Carbon episode of this data series occurred at about 2:00 PM on September 6th. This peak was followed by a smaller episode at about 7:00 PM on the same day. Whereas, the second highest episode occurred at about 7:00 AM on the following day and there were additional elevations at 11:00 AM and 7:00 PM. On the Saturday, September 8th there is a broad peak in the OC concentration time series between 6:00 AM and noon, and both lower concentrations and less observable structure on Sunday, September 9th. Given the timing of these peaks, it appears that they are traffic related. Interestingly enough, 3 strong peaks in the Pb concentration time series (bottom panel) correspond to the highest peaks in the OC series (i.e., 2:00 PM Sept. 6th; and 7:00 and 11:00 AM on the 7th), but there are none corresponding to OC peaks at 7:00 PM on the 6th, or the 7:00 PM on the 7th. Thus, Pb seems to correspond only to morning or afternoon OC peaks, not the evening peaks. One reason for this might be that the Pb is associated with truck traffic, which might peak in the morning and afternoon high-traffic periods, but not during the evening period, when truckers, perhaps, choose not to be stuck in traffic. We may be able to evaluate this hypothesis further by looking at truck traffic counts in the City's toll facilities. Another hypothesis is that City, Industrial, or Federal vehicle fleets emit the Pb. These vehicles (e.g., postal fleet, sanitation and service vehicles, but not public busses) would likely not operate in the evening.

Cytokine Assays. Studies conducted during the 2nd quarter (2001) have established that cultured A549 human lung epithelial cells respond to exposure standard urban particulate matter (NIST 1648 and 1649a particles) by releasing the cytokine IL8. The A549 cells secrete cytokines that attract inflammatory immune cells, such as macrophage. The macrophage secrete cytokines that enhance the inflammatory reponse by interacting with other immune cells such as T cells. Measurable levels of IL8 were released in a dose response manner over a

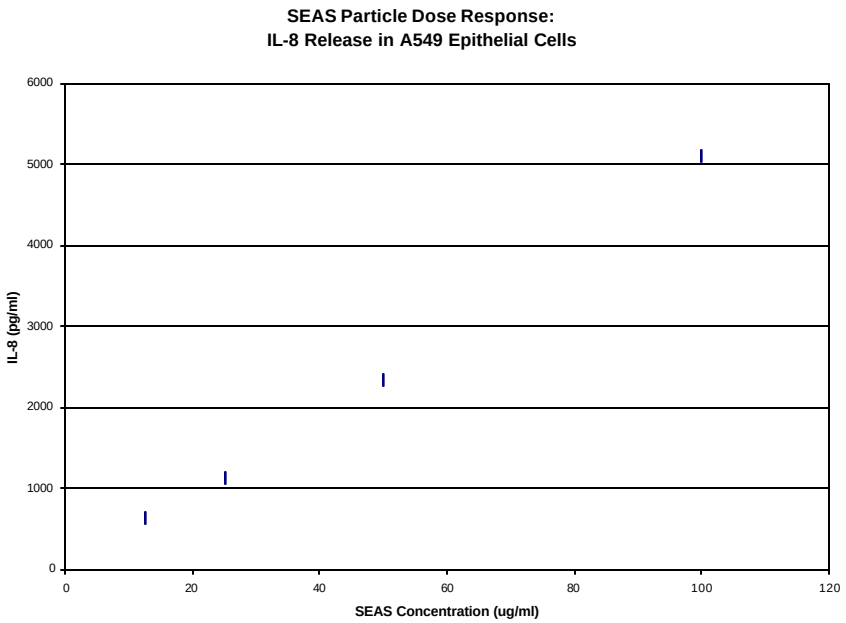

Figure 9. Dose response curve observed for SEAS College Park particle slurry material used to expose human epithelial (A549) cells.

range of 100 to 250 ug/ml with an exposure time of 24 hr.

Air particles <2.5 :m collected by the SEAS instrument as part of this Supersite investigation also stimulated A549 cells to release IL8. A 24 hr sample collected at College Park, MD stimulated cells to release IL8 at calculated *in vitro* particle concentrations as low as 12.5 :g/ml. The response (Figure 9) was linear up to a particle concentration of 100 :g/ml. IL8 concentrations in the media ranged from 629 to 5,000 pg/ml. Cells were also exposed to $ZnCl_2$ at concentrations up to 0.5 mM to establish a positive control for this assay. The IL8 response was similar to that observed for the 1648 particles at Zn concentrations of 0.2 to 0.3 mM. When this assay system was applied to SEAS samples collected for 30-min intervals at College Park, MD quantitatively different responses, with IL8 release ranging from non-detectable (< 20 pg/ml) to 420 pg/ml were observed. Samples collected from South Baltimore, however, did not stimulate a measurable IL8 response. Additional assays showed that Zn exposure at concentrations up to 0.4 mM did not cause significant cytotoxicity (mean LDH release was 5% at 0.4 mM). LDH release of >20% occurred in response to SM 1648 and 1649a particle exposure, but only at a concentrations of 150 ug/ml and higher. Neither the SEAS samples collected at College Park, nor those collected from South Baltimore, were cytotoxic the to A549 cells over the concentration ranges tested. Apparently, release of IL8 by the epithelial cells isn't sensitive enough to respond to the low concentrations in the 30 minute SEAS particles collected at FMC, even though we did get a response with the bulk SEAS particles collected earlier at College Park

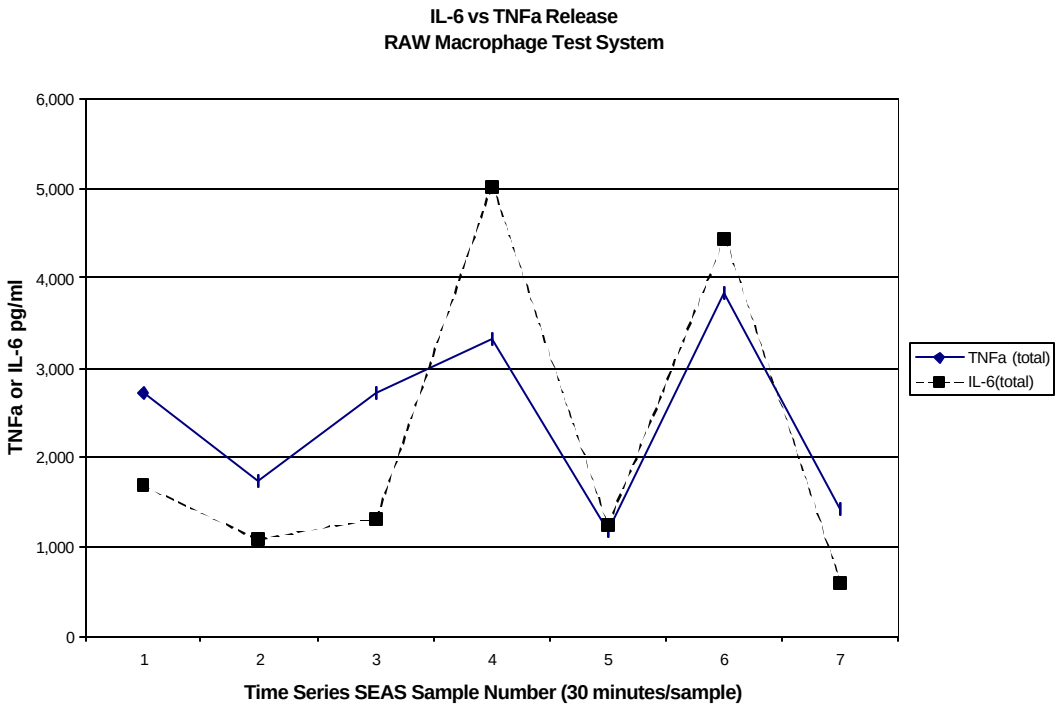

Figure 10. IL6 and TNF_a response is plotted for a series of SEAS samples collected at the FMC site in May, 2001.

Given the lack of IL8 stimulation in A549 cells by the FMC slurry samples, studies were initiated to establish whether or not the RAW264.7 mouse macrophage-like cell line is suitable for use in an assay to determine the ability of particle samples to stimulate the release of cytokines, in this case, TNF_a and IL6,

and the production of reactive oxygen species (ROS) in alveolar macrophage. Responses for TNF_a and IL6 are shown for particles in a series of SEAS samples collected at FMC are shown in Figure 10. As indicated, the pattern of results for these two cytokines was similar, although the IL6 response changed more abruptly. Inspection of Figure 11, wherein IL6 response and Zn concentration are plotted for the same series of SEAS samples, suggest that Zn might have been responsible for the response observed for sample 4; whereas other metals or substances were apparently responsible for the IL6 response observed for the 6th sample. These results suggest that the cytokine assay work proposed for the Baltimore Supersite Project will be sucessful.

Rotating Drum Impactor (RDI). A total of 6 samples were collected at Clifton Park with the 8-stage RDI. Three were collected serially from June 30th until July 22nd. The remaining three RDIs were collected between August 3rd and September 14th (see also Figure 1). Cutpoints of the RDI ranged from approximately 12 to 0.07 :m. All rotating drum impactor samples have been returned to U.C. Davis. Samples are being selected for analysis by synchrotron XRF.

Single Particle MS. Construction of the single particle mass spectrometer was completed and the unit was undergoing tests during the month of June. One vender delivered the high voltage power supplies 2.5 months late, which caused us to miss the intensive period. The instrument was up and running for a short time but arson at the site precluded much data collection. The instrument has been shipped back to the University of Delaware. New components have been ordered to build a new machine for the Baltimore supersite. The crucial power supplies are not being ordered from the same late vender as last time to avoid those delays. Some of the RSMS3 components have been cleaned and can be used for the new instrument, which will save substantial time. Prachi Middha, a graduate student, is working on improving the inlet efficiency using matched aerodynamic lenses to improve its focusing characteristics.

Organic Compound Sampler. Our custom-built sequential organic filter/PUF sampler was designed to permit sequential sampling for up to 5 periods at flowrates up to 500 LPM or sequential sampling with 4 channels and simultaneous collection of a 24-hr sample at 100 LPM. The unit was fully assembled at Clifton Park, but had to be removed for cleaning. The electronic components have been replaced and some additional modifications have been made. All of the parts have been received and the unit is now fully assembled and ready for testing.

Ultra-High-Volume Aerosol Sampler. The new 15-filter cassette box, installed inside the trailer by NIST, has been tested. This unit and the old 10-filter cassette box were installed inside the trailer and have undergone testing. It appears that ambient indoor trailer temperature is insufficient to prevent water from condensing on the filters during high relative humidity conditions. As these conditions occur with substantial frequency, the filter cassettes are being moved to the roof, where solar heating has been adequate to prevent condensation most of the time. A computer control program has been designed and will be coded in visual basic in January, 2002.

Data base development. The database has been created and tables for data from the following

instrument types have been defined:

* 3D Sonic Anemometer
* APS
* CPC (May need work, based on initial file info.)
* CSAS
* Gases (CO, NO2, NOX, O3, SO2)
* Nitrate
* SEAS
* SMPS
* SPMS (May need work - based on initial file info.)

Import routines were completed for output files of all instruments operated at the Baltimore Supersite, except for the FRM and Speciation montitors. all raw data have been loaded into the database.

Website: Our Static Web site (www.chem.umd.edu/supersite) contains color maps of the Baltimore Region have been prepared in ARCVIEW and loaded onto our website. The maps show major PM emission sources (obtained from the EPA AIRS data base), metals emission sources (TRI data), and estimates of emissions as well as the location of our sampling sites and key streets. Recently, we've added a site plan for the supersite at Clifton Park; our position papers on the RH issue and allocation of intensive resources; the efficiency curve for the UMCP all glass inlet impactor; SEAS data taken at College Park, MD, showing resolution of sources; and a 2-D scan showing relative particle concentration data showing traffic pollution over Baltimore streets. Current versions of all SOPs are now available on the web site.

Personnel Changes. Dr. YuChen Chang will return to her University duties in Taiwan in early February, according to plan. She has been responsible for the design, construction, and implementation of the sequential high-volume organic compound sampler and in charge of SEAS development. Additionally, Ms. Jennifer Moore and Dawn Catino will complete their MS degrees and leave in January. Six new staff people have been hired for the Baltimore Supersite project. Dr. David Harrison, formerly, with Harvard School of Public Health will assume responsibility of day-to-day operation of the Supersite field measurements. Professor Narayanan Nair, will be responsible for quality assurance and data integrity at the investigator level. Dr. Sarala Gajula has been hired to maintain and operate SEAS at the Baltimore Supersite. In addition, Albert Alford has been hired part time as a field sampling technician to assist in operation of field instruments, specifically, gas and semi-continuous speciation monitors. A second, technician, Mr. Kristopher Kernighan will provide logistical and field instrumentation support 3 days a week. Professor Narayanan was formerly the Head of the Aerosol Monitoring Section at the Bhabha Atomic Research Center in Mumbai, India. Dr. Gajula is a Ph.D. chemist with experience with large SQL data bases. Mr.Alford worked as a field technician supporting utility air monitoring stations. Lastly, Dr. Park Seung Shik will assist in data analysis and preparation of reports and publications, starting in March, 2002. Park has experience with multivariate statistical models for source attribution.

Publications/Presentations/meetings: Presentations were made at the EPA Supersite Contractors meeting in November 2001.

Two papers are to be presented at the NETL conference, "PM2.5 and Electric Power Generation: Recent Findings and Implications," to be held at the Omni William Penn Hotel, Pittsburgh, PA, April 9-10, 2002. These are: Suarez and Ondov, Contributions of Some Cytokine Active Metals in Ambient Particles Attributed to Coal Combustion by CMB.; and Ondov et al., Resolution of Contributions of Primary Particle Constituents from Individual Power Plants with SEAS.

AAAR, 2001: Source Identification by a Multilinear Receptor Model Using Highly Time Resolved Chemical Composition and Wind Data, XIN-HUA SONG, Clarkson Univ, Philip K. Hopke, Clarkson Univ, Pentti Paatero, Univ of Helsinki, John M. Ondov, Univ of Maryland, Christopher B. Kidwell, Univ of Maryland

In Vitro Assay of the Biological Activity of Ambient $PM_{2.5}$ Collected By A High Frequency Aerosol Sampler. R Mitkus[1], M Falconer[1], J Powell[1], J Ondov[2], K Squibb[1], University of Maryland, Baltimore, MD and [2]University of Maryland, College Park, MD

Future Activities.

1. We will continue to hold weekly PI teleconferences as needed.

2. SEAS:Additional SEAS samples are being selected for for cytokine assay testing. A new control program will be designed and implemented.

3. Database: SMPS and APS data will be transformed and input into the data base. Tables for SEAS elemental and Cytokine data, as well as those for FRM, speciation, and gas (Clfiton) monitors will be defined, import routines for these will be developed, and the data imported. Daily logs and instrument diagnostic data are being reviewed and will be used to set data quality flags inthe data base.

4. The Delaware group will continue testing and repairing components from the old mass spectrometer and rebuilding the instrument. The completed machine will be tested prior to anticipated delivery to the site by early March.

5. A new control program for the ultra high-volume aerosol collector is scheduled to be installed in January.

Supplemental Keywords: Single Particle Mass Spectrometry, ROS, Cytokine, Receptor Modeling

Met Data Progress Report
for time: II/2001

05/26 deployment of sensors and erection of tower
05/27, 9am start of measurements
instruments: rain gage sampled at 1 Hz
Vaisala hygrometer and temperature sensor at 4.75m and 1Hz
2 Cup anemometers at 5.7m and 10.24m and 1 Hz
wind vane at 10.24m at 1 Hz
measured variables: relative humidity (RH), Temperature in degrees Celsius, length of horizontal wind vector in m/s, wind direction in degrees
derived variables: standard deviation of wind direction, mean horizontal wind velocity (vector and scalar method)

05/30 additional instrument: 3 dimensional campbell scientific sonic anemometer (CSAT3 3-D Sonic Anemometer)
additional measured variables: all three components of wind vector in m/s at 8.94m sampled at 10 Hz, virtual potential temperature in degrees Celsius at 10 Hz
additional derived variables: 10 min averages of (col 4-14 in ave files): air temperature [^o C], relative humidity [%], velocity for first cup (scalar and vector mean) [m/s], velocity for the second cup (scalar mean) [m/s], horizontal wind direction [^o], std deviation of horizontal wind direction [^o], rain (sum over 10 min) [mm], friction velocity u* [m/s], Obukhov length L [m], sensible heat flux H [J/m^2s]

06/15 14h end of measurements at FMC

missing values for duration of >1 hour:
05/30 20h-22h all instruments
06/04 12h - 06/05 16h all instruments

data quality
all sensors functioned properly during all times, intercomparison of data from 3d sonic anemometer with cup anemometers and vaisala temperature probe assures data quality

completeness (during 5/27 - 6/15):
30 hours missing out of 457 --> 93% complete

data presentation
all data is available as graphs at
http://www.jhu.edu/~dogee/mbp/index.html
raw data files and averaged statistics are backuped on DVD and stored on FATBOY

Lidar Data Progress Report
for time: II/2001

05/22 start of the measurements
measurement days:
May: 22, 23, 24, 25, 27, 28; June: 5, 6, 7, 8, 9, 10, 11, 12, 13, 14.

type of data
vertical scan at a wavelength of 1064 nm with a duration of 5, 15 or 30 min.

data presentation
raw data files are backuped in DVD and stored on FATBOY

All plots, with background substration and range correction are available at
http://www.jhu.edu/~dogee/mbp/supersite2001/lidar_data.htm